Fish & Wildlife Division

RESOURCE DATA AND SPECIES AT RISK SECTION

Western Spiderwort (*Tradescantia occidentalis*) Inventory in Alberta, 2005

Alberta Species at Risk Report No. 102

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

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Kirsten J. Remarchuk

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EXECUTIVE SUMMARY

Western spiderwort is listed as *Threatened* by COSEWIC (2005) and has been recommended for *Endangered* status by the Alberta Endangered Species Conservation Committee (ESCC). In 2004, the Alberta Western Spiderwort Recovery Team created a maintenance and recovery plan for western spiderwort in Alberta. In addition to identifying several knowledge gaps in various aspects of this species' biology, the plan calls for an annual population inventory of western spiderwort. The objective of this study was to complete a population inventory for the year 2005 using a method that could be repeated in future studies. Limited information on habitat requirements was also provided.

Survey methods followed Peters (2003a). Eleven polygons were counted and the boundaries delineated by a GPS. Due its large size, the entire population could not be counted. For uncounted polygons, GPS points were taken at the boundaries of the polygons and the number of individuals was estimated using an average density. The density was calculated as the number of plants per square meter and was averaged from the 11 enumerated polygons.

Western spiderwort has been confirmed in one location in Alberta. Other suitable habitats have been surveyed in previous years with no success (Peters, 2003a, b). Western spiderwort occurs in the Pakowki Lake sandhills near the town of Manyberries in the Dry Mixed Grass Subregion. In this inventory, the population was estimated to consist of approximately 28,400 individuals (56,800 stems), which is considerably larger than the previous estimate of 7,700 individuals (Peters, 2003b). A total of 1,529 individuals (3,035 stems) were counted in 11 polygons. The area covered by western spiderwort was 176,203 m^2 in 2005 compared to an area of 19,890 m^2 in 2002.

An individual is defined as a multi-stemmed shoot in which all shoots originate from the same point in the soil. On average, western spiderwort has 2.3 stems per individual using this definition. Approximately 90% of the stems counted are reproductive meaning they have buds, flowers or capsules. Only about 6% of stems are grazed. The estimate of grazing may be low due to the difficulty in locating stems that have been severely browsed. Browsing did not appear to have a significant impact on the population as many browsed stems regrew reproductive structures. Cattle had not yet been released into the population for the 2005 season indicating that grazing at the time of this study is primarily by native ungulates.

The patches of spiderwort found in the 2005 survey were considerably larger and more numerous than those found in previous years. The large increase in numbers reported may be due in part to an increase in population number or may be an artefact of a more detailed search of the area. Spiderwort inventories need to be conducted annually to monitor changes in population number. Selected polygons should be counted each year to better estimate changes in population number. In addition, information on the effects of grazing and precipitation and on habitat requirements must also be acquired in future studies.

1.0 INTRODUCTION

Western spiderwort (*Tradescantia occidentalis*) is one of only two members of the Commelinaceae family native to Canada. This species is a perennial monocot that at first glance appears grass-like in morphology. Western spiderwort grows to a height of 50 cm, with linear, sheathing leaves up to 30 cm long. The roots are fleshy and semi-succulent and are often mistaken for rhizomes. This type of root growth is specialized for dry environments. The flowers are dark blue to purple in colour with three petals and three sepals (Photo 1). In the Manitoba population, rose-coloured flowers have also been observed (pers. obs.). The six purple stamens have bearded hairs on the filaments. Each flower produces three to six seeds which are dispersed close to the parent plant by gravity and possibly by wind, rain or snowmelt (Smith, 2002). Upon injury of the stem or leaves, the plant produces a mucilaginous substance that resembles a cobweb when hardened.

While the exact habitat requirements for western spiderwort remain unknown, it has been observed that this species is limited to sand dune complexes and surrounding sandy areas (Goulet and Kenkel, 1997; Smith, 2001). In Alberta, the majority of the population is found on vegetated south-facing slopes of small sand dunes or in open meadows with small undulating hills (pers. obs.). This is in contrast to the habitat requirements in Saskatchewan and Manitoba, where western spiderwort is primarily found on open dune faces (pers. obs.).

Western spiderwort is listed by the Committee on the Status of Endangered Species in Canada as *Threatened* (COSEWIC, 2002). In Alberta and Saskatchewan, this plant has been recommended for provincially *Endangered* status (Alberta's Endangered Species Conservation Committee, 2005; Wild Species at Risk Regulations, 2005), while in Manitoba this species is provincially *Threatened* (Manitoba Conservation Data Centre, 2005). There are several reasons for its status. Western spiderwort is limited to five populations in Canada; one in southeastern Alberta, one in south central Saskatchewan, and three in southwestern Manitoba. The Alberta and Saskatchewan populations are completely isolated from other Canadian populations as well as from the core range in the United States. Habitat loss, from conversion of native pasture to agricultural land, petroleum exploration and development and dune stabilization, is also a threat to the stability of western spiderwort. Grazing at certain times of the season may be detrimental to the conservation of this species if it prevents a significant amount of seed set. In addition, in some populations the encroachment of invasive weeds, in particular leafy spurge (*Euphorbia esula*), contributes to the nationally *Threatened* status of this species. Current and future management regimes, such as suppression of fire on the landscape, may also contribute to the status of this species.

The purpose of this study is to conduct a population inventory for western spiderwort and to contribute to the understanding of the population dynamics and general biology of this species. The main objectives are to provide an accurate estimate of the population, and to propose a method of population inventory that can be repeated consistently in the future. Additional objectives include providing information on habitat requirements, presence of invasive species and grazing by native ungulates.

The objectives listed above correspond with the *Maintenance and Recovery Plan for Western Spiderwort in Alberta* (Alberta Spiderwort Recovery Team, 2004). The recovery team acknowledges several knowledge gaps in the areas of habitat requirements, effects of precipitation and grazing, pollination biology, availability of the seed bank, invasive species and genetics. The action plan includes the development of a standardized protocol for population inventory, which is to be conducted annually. This study provides information on population numbers, specific habitat requirements, and vegetation encroachment on the dunes and fulfills the requirement for an annual population inventory.

2.0 STUDY AREA

In Alberta, western spiderwort is located southwest of the town of Manyberries in the Dry Mixedgrass Subregion of the Grassland Natural Region (ANHIC, 2004). Most of the sections containing western spiderwort are leased, though a few are deeded (Peters, 2003a). The legal land location is T5-R7-W4 on topographic map 72 E/7. See Figure 1 for the general location of western spiderwort in Alberta. This area is warm and dry, with a mean temperature of 16°C and a total precipitation of approximately 200 mm over the months of May through August (Environment Canada, 2005).

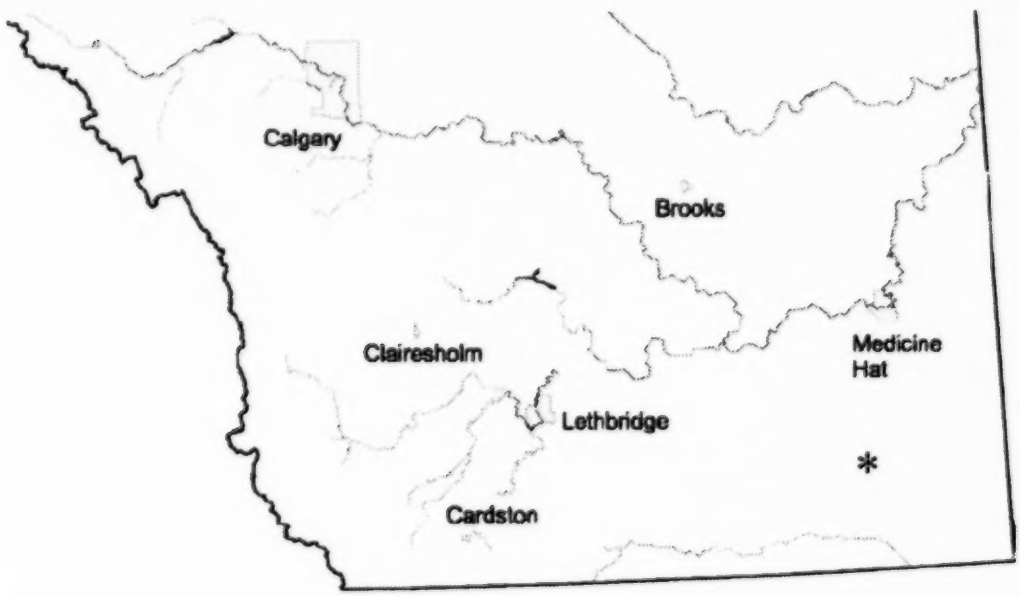

Figure 1: The general location of western spiderwort in Alberta. The population is indicated by an *. (Map modified from Peters (2003a).)

The area containing western spiderwort consists of small sand dunes, generally with an open face to the north and a vegetated slope to the south, and open prairie with gentle,

undulating hills (Photos 2 and 3). Grasses, including needle-and-thread grass (*Hesperostipa comata* subsp. *comata*), june grass (*Koeleria macrantha*), and fescue (*Festuca brachyphylla*) dominate the landscape. Shrubs, including prairie rose (*Rosa arkansana*), buckbrush (*Symphoricarpos occidentalis*), and chokecherry (*Prunus virginiana*) are common on vegetated south-facing slopes or in low areas and on the prairie. Small pockets of larger trees, such as trembling aspen (*Populus tremuloides*) and plains cottonwood (*Populus deltoides*), occur throughout the dunes. Other associated graminoids include blue grama grass (*Bouteloua gracilis*), Indian rice grass (*Achnatherum hymenoides*), sand grass (*Calamovilfa longifolia*), and sand drop seed (*Sporobolus cryptandrus*). Several forbs are also commonly found in this region. These species include the following: fringed gromwell (*Lithospermun incisum*), Fendler's cryptanthe (*Cryptantha fendleri*), prairie sagewort (*Artemesia ludoviciana*), plains wormswood (*Artemesia campestris*), purple prairie clover (*Dalea purpurea*), and selaginella (*Selaginella densa*).

3. 0 METHODS

Landowners and leaseholders were contacted by Alberta Sustainable Resource Development prior to conducting searches to acquire permission to access the spiderwort population. Permission was granted to all requested areas.

The population inventory was conducted between July 14th and July 18th in an attempt to conduct the inventory during flowering season. This year a significant portion of the population was senescing during the inventory. Population estimates were conducted based on a previous count by Sue Peters (2003a) in which the individuals within a polygon were counted and the area around the polygon delineated with a Garmin eTrex GPS unit. The GPS unit had an accuracy of less than three meters.

Initially, known polygons from previous studies (ANHIC, 2005) were located. The number of individuals within each polygon was counted and the boundaries were defined by data points acquired with a GPS unit. An individual is defined as a multi-stemmed shoot, with each stem originating from the same point in the soil. This definition differs from other definitions because it is now known that individuals are not joined rhizomatously. The fleshy roots of western spiderwort have previously been mistaken for rhizomes (Photo 4). The number of individuals in every polygon could not be counted because of the large number of individuals and because of time constraints. As a result, all of the known polygons were located and the boundaries delineated. Searches for additional patches were conducted both by walking roughly parallel transects and by meandering across the area known to contain western spiderwort. This area is inclusive of but not limited to the sand dune complex.

An average density was calculated by averaging the number of individuals per square meter in the 11 polygons counted. Using ArcView 3.2, the area of the polygons that were not counted was estimated and the average density was extrapolated to those polygons. A total population estimate was obtained by summing the counted and extrapolated polygons. Information collected in each polygon includes the number of stems per plant,

evidence of browsing, and the number of stems with reproductive structures (fruit or flowers).

In addition to a population inventory, plant species associated with western spiderwort were recorded. A species list was also composed for the areas that appeared to be suitable for western spiderwort but from which spiderwort was absent for the purpose of comparing floristics.

4.0 RESULTS

In the 2005 field season, a total of 1,529 plants (3,035 shoots) were counted in 11 polygons. Using the extrapolation method described above, the tota' population is estimated at 28,400 individuals (56,800 shoots). The extent of western spiderwort range in Alberta is over 2 km^2. The area occupied within that range is approximately 176,203 m^2.

The average density of western spiderwort is 0.16 individuals/m^2. The average number of shoots per plant is 2.3 using the new definition of an individual. An estimated 90% of counted plants have reproductive structures. The population estimates were conducted later in the season than previous studies. As a result, many plants were setting seed and beginning to senesce (Photo 5). Only an estimated 6.1% of counted plants are browsed. Some severely browsed plants may have been missed due to difficulty in locating the plants. Appendix I contains a summary of the population data collected in 2005.

Western spiderwort is found in several different habitat types. Small patches of western spiderwort are found on south, southwest or southeast facing slopes of small partially active sand dunes. The south aspect has a tendency to be well vegetated and western spiderwort is often found in dense stands of rose (Photo 6). Very few plants were found in areas of active sand. The majority of the population was found on gently rolling stabilized sandhills (Photos 7 and 8). Plants found in the stabilized sandhills appear more robust than plants found in areas of open sand.

A species list has been prepared for areas with and without western spiderwort. There is little difference in floristics between the two areas, though western spiderwort does not appear to grow with sand drop seed (*Oryzopsis hymenoides*), which primarily grows in areas of active sand. See Appendix II for species lists.

Population data from the 2005 inventory is stored in the Alberta Natural Heritage Information Center (ANHIC) database. Detailed location information on the polygons is also stored in the ANHIC database but has not been released in this report due to the sensitivity of rare plant information.

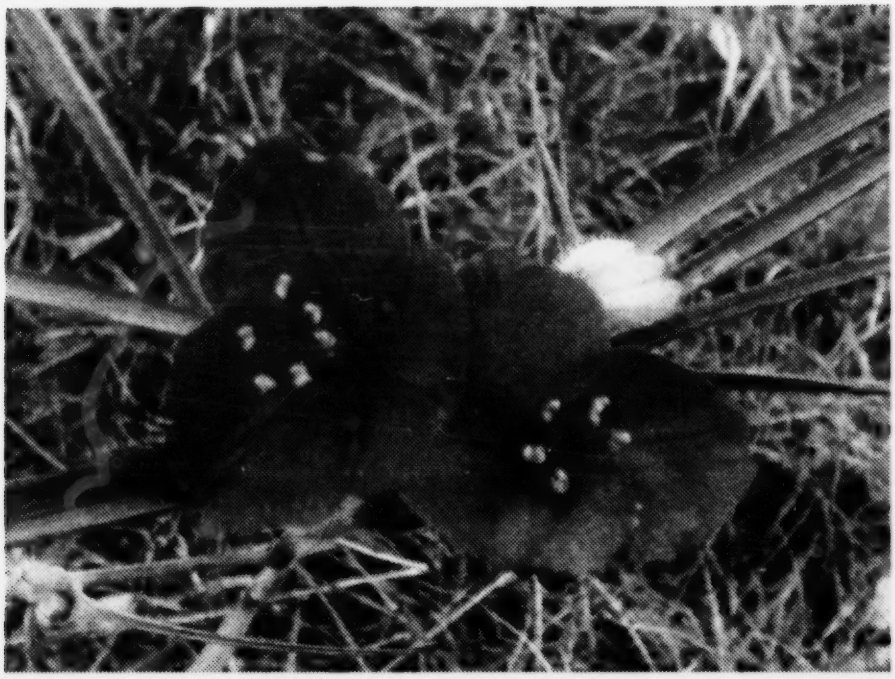

Photo 1: Western spiderwort flowers.

Photo 2: Semi-active dune complex.

Photo 3: Gently undulating landscape with sandy soil.

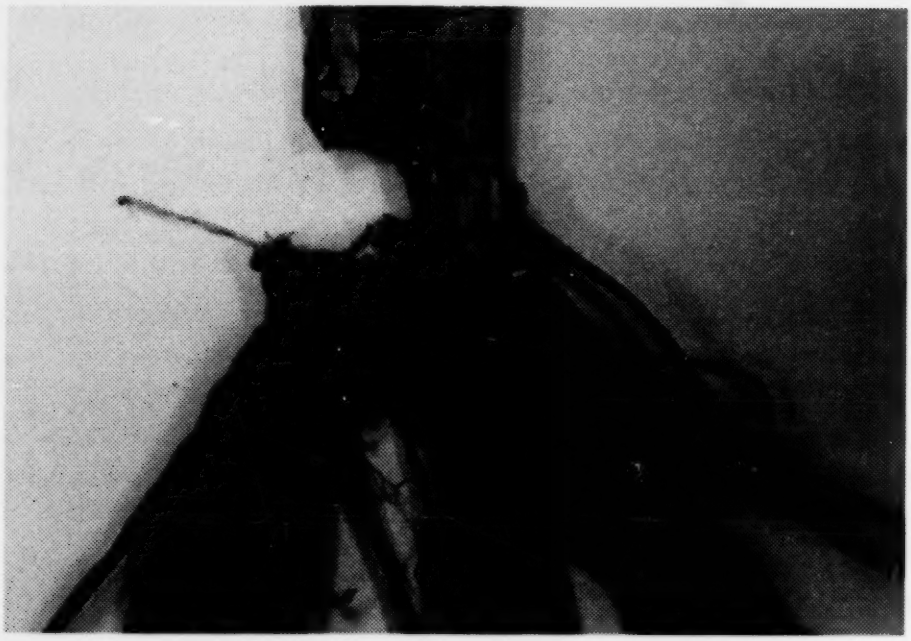

Photo 4: Root system and underground structures of western spiderwort.

Photo 5: Western spiderwort senescing.

Photo 6: Spiderwort habitat in dense shrubs.

Photo 7: Typical western spiderwort habitat in Alberta.

Photo 8: Western spiderwort habitat near Manyberries, AB.

5.0 DISCUSSION

The population estimate for 2005 exceeds previous population estimates. The western spiderwort inventory for 2003 estimated a population of 7,700 plants (Peters, 2003b). Prior to the 2002 estimate of 7,450 individuals (Peters, 2003a), the largest estimate of the Alberta population was 210 individuals in 1990 (Smith 2001, 2002). In 2001, a meagre seven individuals were located (Smith, 2001). The population was originally located in the 1970's, but until 2002 inventories focused on the semi-active sand dune complexes. The majority of the population is actually found in well vegetated sandy areas and thus a large component of the population may have been missed in previous searches. While the 2002 and 2003 population inventories focused on both areas, several additional patches of western spiderwort were found in 2005. In addition, several of the polygons known from previous studies were considerably larger in size and number. The new patches may be indicative of the spread of western spiderwort; however, it is likely that the perceived increase in population is due at least in part to discovering patches that were previously overlooked.

Western spiderwort can be difficult to locate without flowers because its vegetative parts resemble members of the grass family. The flowers open early in the morning, usually between 5 a.m. and 5:30 a.m. and close around 1 p.m. The opening and closing of the flowers appears to be dependent on temperature. Flowers close earlier on hot, sunny days than on cooler overcast days (pers. obs.). Meandering searches were conducted into the afternoon, but population counts were primarily conducted in the morning to maximize the accuracy of the count. At the time of the study, a number of plants were already beginning to senesce. At the onset of senescence, western spiderwort turns a yellow colour (Photo 5), which contrasts with the green colour of grasses. This makes locating individuals of western spiderwort considerably easier when no flowers are remaining. Godwin and Thorpe (2005) attributed the yellowing to possible fungal infection in the Saskatchewan population. They also noted that plants were drying and turning black. While there were brownish spots on some of the leaves, it has not yet been confirmed that there is any evidence of fungal infection or disease in the Alberta population. All plants appeared to be in the natural process of senescence.

Previous studies have indicated that precipitation is correlated with fluctuations in population size of western spiderwort. Peters (2003a, b) stated that high spring moisture levels in southeastern Alberta in 2002 contributed to the high number of western spiderwort plants. Likewise, Smith (2002) correlated decreased population numbers with low spring moisture. However, it is difficult to determine whether the correlations between spring moisture and population fluctuations are artefacts of inconsistent population sampling methods. It is unlikely that between 1990 and 2002, the population increased so dramatically, especially considering the limited dispersal mechanisms of western spiderwort seed. Dispersal occurs primarily by gravity but wind and rain may also contribute to dispersal over short distances. It is unknown whether there are any long distance dispersal mechanisms for this species. This species does not reproduce vegetatively as indicated by a lack of underground structures. The only underground

structures present are the fleshy roots and the scar from the previous year's growth (Photo 4).

There are no immediate threats to the stability of the Alberta population. Dune stabilization has been a concern for this species because in previous studies across all three provinces, spiderwort was found on semi-active dunes. Recent studies have suggested that spiderwort grows equally well in vegetated areas (Goulet and Kenkel, 1997) as indicated by the presence of reproductive structures and seed set. Data from this inventory indicates that western spiderwort is more abundant in well-vegetated areas. Plants in well vegetated habitats appear healthier and more robust than individuals in open sand (pers. obs.). The possibility that plants on semi-active dunes may be marginal in Alberta should be considered.

Anthropogenic factors also have an impact on the population in the future. The management decisions of landowners and leaseholders, which are primarily concerned with grazing practices and petroleum exploration, may affect the population. It does not appear that conversion to crop land is a realistic development considering soil conditions and topography (pers. obs.). Currently, there is no petroleum exploration, though it is a future consideration.

Invasive species and grazing have also been identified as threats to western spiderwort. The area searched for western spiderwort in Alberta did not contain leafy spurge and it was not noted in nearby areas. Overall, the area appears to be rich in native flora and it is likely that invasive weeds do not pose an immediate threat to the Alberta population. The Saskatchewan and Manitoba populations are all threatened by leafy spurge (Goulet and Kenkel, 1997; Smith 2001a). The spiderwort population had not been grazed by cattle in 2005, though leaseholders were scheduled to release cattle the following week. In previous years, rotational grazing was practiced in western spiderwort habitat. Based on the status of the population, current grazing regimes do not appear to have a negative impact on the population. However, overgrazing by cattle may be a potential threat to western spiderwort and may permit an invasion of weeds, particularly if bales are used as a supplementary food sources for cattle.

Two consecutive population counts of several thousand plants in 2002 and 2003 suggest that this plant may not undergo extreme population fluctuations to the extent previously thought. The most reasonable explanation for the recorded differences is inconsistent search methods over the years. However, the population does seem to have expanded since the 2003 inventory as some of the re-counted polygons had increased in number.

Following the World Conservation Union red list categories and criteria, western spiderwort qualified as *Endangered* because of population fluctuations, the small number of populations and isolation of the populations from each other and from the main distribution in the United States (Peters, 2003a). A future re-assessment of the status of this species will take into consideration the new information brought forth by this and other recent publications. Recent inventories suggest that population fluctuations may be less dramatic than previously thought; however, continued consistent monitoring is

necessary to more fully understand the nature and extent of any population fluctuations. The results of the 2005 population inventory do not change the COSEWIC status or the status recommended for listing under the Alberta Wildlife Act.

Few differences were noted in floristic composition between areas with and without spiderwort. Available habitat suitable for western spiderwort is also located at Pakowki Lake South, One-Four, Turin, Purple Hills, Lazy H, Hilda and Whiskey Gap but no spiderwort has been located in those regions (Peters, 2003a, b). Barriers to dispersal may limit the spread of western spiderwort to these locations. Further investigation into specific habitat requirements should be conducted.

6.0 MANAGEMENT IMPLICATIONS AND FUTURE DIRECTIONS

In early 2005, a maintenance and recovery plan for western spiderwort in Alberta was drafted by the Alberta Western Spiderwort Recovery Team (2004). The recovery team includes members of the Alberta government, a conservation agency, and members of the community. The plan acknowledges several areas in which more information is required, including habitat requirements, effects of precipitation and grazing, pollination biology, availability of the seed bank, impact of invasive species, and knowledge of the genetic structure of the population.

The action plan involves population and habitat conservation and management, information and education for the general public and people affected by the presence of western spiderwort, and research into knowledge gaps. Resource acquisition, legislation and plan management and administration are also considered. Population management includes annual population surveys and surveys for invasive species. It also calls for a standardized population estimation protocol. The polygon extrapolation method designed by Sue Peters (2003) and employed in the 2005 survey worked well for the spatial distribution of the Alberta population; however the method is not strongly supported statistically. The statistical support may be strengthened by increasing the number of polygons counted. It is recommended that this method be used in future surveys and that polygons counted in this study be counted in subsequent surveys. By recounting the same polygons in following surveys, an accurate estimation of population growth or decline can be made. Additional patches of western spiderwort may be identified in future studies, thereby changing the overall population estimation. However, because population numbers are substantial and the population appears to be stable, monitoring changes in numbers by counting known polygons is much more valuable to the understanding of this species. By monitoring changes in known polygons, meaningful correlations between environmental conditions and grazing can be made with population number.

More research into habitat requirements and other aspects of the biology is needed to effectively conserve this species. This study focuses on providing information on the population dynamics of western spiderwort and ideally contributes to a standardized population estimation protocol in Alberta. Some information on the habitat requirements is also provided. Next field season, in addition to a population inventory, an investigation

into habitat requirements and other knowledge gaps should be conducted to understand why this species has such a limited distribution.

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URL: http://www.canlii.org/sk/laws/regu/w-13.11r.1/20050801/whole.html

Appendix I: Summary of the 2005 western spiderwort polygon data for Alberta.

Polygon	*Area (m^2)*	*Method*[1]	*# Plants*[2,3]	*# Stems*[4]	*Av. Stems/Plant*	*% Reprod. Plants*	*% Reprod. Stems*	*% Plants Browsed*	*% Stems Browsed*
1	271.36	Counted	39	92	2.4	100	91.3	1.0	2.5
2	384.57	Counted	622	1077	1.7	100	96.1	0.5	0.8
3	483.79	Extrapolated	78	157	n/a	n/a	n/a	n/a	n/a
4	323.54	Counted	38	68	1.8	100	98.5	2.9	5.3
5	39.62	Extrapolated	6	13	n/a	n/a	n/a	n/a	n/a
6	487.24	Counted	38	144	3.8	97.4	86.1	6.9	10.5
7	124.43	Extrapolated	20	40	n/a	n/a	n/a	n/a	n/a
8	170.85	Counted	24	83	3.5	100	84.3	6.0	12.5
9	10006.37	Extrapolated	1615	3255	n/a	n/a	n/a	n/a	n/a
10	10925.11	Extrapolated[5]	839	1543	1.8	99.6	91.9	4.4	6.6
11	484.79	Counted	75	165	2.2	100	89.1	10.9	9.3
12	162.05	Counted	53	151	2.9	100	87.4	9.9	17.0
13	3966.1	Extrapolated	640	1291	n/a	n/a	n/a	n/a	n/a
14	140.99	Counted	52	78	1.5	100	88.5	10.3	15.4
15	1843.37	Counted	239	560	2.3	99.2	80.4	14.8	13.8
16	368.53	Extrapolated	59	120	n/a	n/a	n/a	n/a	n/a
17	670.0	Extrapolated	108	17	n/a	n/a	n/a	n/a	n/a
18	3617.52	Extrapolated	584	1177	n/a	n/a	n/a	n/a	n/a
19	13137.52	Extrapolated	2120	4275	n/a	n/a	n/a	n/a	n/a
20	380.77	Counted	20	25	1.5	94.1	80	44.0	52.9
21	5471.02	Extrapolated	883	1780	n/a	n/a	n/a	n/a	n/a
22	2449.53	Extrapolated	395	797	n/a	n/a	n/a	n/a	n/a
23	20210.39	Extrapolated	3262	6576	n/a	n/a	n/a	n/a	n/a
24	43817.10	Extrapolated	7072	14258	n/a	n/a	n/a	n/a	n/a
25	5239.54	Extrapolated	846	1704	n/a	n/a	n/a	n/a	n/a
26	51027.94	Extrapolated	8235	16604	n/a	n/a	n/a	n/a	n/a
Total	176203.8		28430	56834					

1. Some polygons were counted. Others were extrapolated using an average density and GPS boundaries.
2. A plant is defined as a multi-stemmed shoot where the stems originate from the same point in the soil.
3. Average plant density is 0.1614 plants/m^2 using the 11 counted polygons.
4. Average stem density is 0.3254plants/m^2 using the 11 counted polygons.
5. In an area of 3027.95m^2, 592 stems and 322 individuals were counted. The remaining area was extrapolated using the average density of the polygon.

Appendix II: Species found in suitable habitat for western spiderwort. Column A lists species found associated with western spiderwort. Column B lists species found in suitable habitat that did not contain western spiderwort.

Column A	**Column B**
ASTERACEAE	
Artemisia campestris (plains wormswood)	*Artemesia campestris*
Artemisia frigida (pasture sagewort)	*Artemesia frigida*
Artemisia ludoviciana (prairie sagewort)	*Artemesia ludoviciana*
Helianthus pauciflorus subsp. *subrhomboideus* (rhombic leaved sunflower)	*Helianthus pauciflorus* subsp. *subrhomboideus*
Heterotheca villosa (hairy prairie golden aster)	*Heterotheca villosa*
Liatris punctata (blazing star)	*Liatris punctata*
Lygodesmia juncea (skeletonweed)	*Lygodesmia juncea*
Solidago rigida (stiff goldenrod)	*Solidago rigida*
Symphyotrichum laeve (smooth aster)	*Symphyotrichum laeve*
Tragopogon dubius (goat's beard)	*Tragopogon dubius*
BORAGINACEAE	
Cryptantha fendleri (Fendler's cryptanthe)	*Cryptantha fendleri*
Lithospermum incisum (fringed gromwell)	*Lithospermum incisum*
BRASSICACEAE	
Erysimum inconspicuum (small-flowered rocket)	*Erysimum inconspicuum*
Lepidium densiflorum (common peppergrass)	*Lepidium densiflorum*
CACTACEAE	
Coryphantha vivipara (cushion cactus)	*Coryphantha vivipara*
Opuntia polyacantha (prickly pear)	*Opuntia polyacantha*
CAPRIFOLIACEAE	
Symphoricarpos occidentalis (buckbrush)	*Symphoricarpos occidentalis*
CARYOPHYLLACEAE	
Lychnis drummondii	*Lychnis drummondii*
CHENOPODIACEAE	
Chenopodium subglabrum	*Chenopodium subglabrum*
COMMELINACEAE	
Tradescantia occidentalis (western spiderwort)	
CYPERACEAE	
Carex inops subsp. *heliophila*	*Carex inops* subsp. *heliophila*
ELAEAGNACEAE	
Elaeagnus commutata (silverberry)	*Elaeagnus commutata*
EQUISETACEAE	
Equisetum laevigatum	*Equisetum laevigatum*

FABACEAE	
Dalea purpurea (purple prairie clover)	*Dalea purpurea*
Glycyrrhiza lepidota (wild licorice)	*Glycyrrhiza lepidota*
Thermopsis rhombifolia (golden bean)	*Thermopsis rhombifolia*
JUNCACEAE	
	Juncus balticus (wire rush)
LILIACEAE	
Maianthemum stellatum (false solomon's seal)	*Maianthemum stellatum*
ONAGRACEAE	
Oenothera nuttallii (white evening primrose)	*Oenothera nuttallii*
POACEAE	
	Achnatherum hymenoides (rice grass)
Bouteloua gracilis (blue grama grass)	*Bouteloua gracilis*
	Bromus inermis (smooth brome)
Calamovilfa longifolia (sand grass)	*Calamovilfa longifolia*
	Elymus canadensis (Canada wild rye)
Elymus lanceolatus subsp. *lanceolatus* (northern wheat grass)	*Elymus lanceolatus* subsp. *lanceolatus*
Festuca brachyphylla (fescue)	*Festuca brachyphylla*
Hesperostipa comata subsp. *comata* (needle-and-thread grass)	*Hesperostipa comata* subsp. *comata*
Koeleria macrantha (june grass)	*Koeleria macrantha*
Pascopyrum smithii (western wheat grass)	*Pascopyrum smithii*
Poa pratensis (Kentucky bluegrass)	*Poa pratensis*
Sporobolus cryptandrus (sand drop seed)	*Sporobolus cryptandrus*
POLYGONACEAE	
Rumex venosus (veined dock)	*Rumex venosus*
ROSACEAE	
Chamaerhodos erecta	*Chamaerhodos erecta*
Prunus virginiana (chokecherry)	*Prunus virginiana*
Rosa arkansana (prairie rose)	*Rosa arkansana*
SALICACEAE	
	Populus deltoides (cottonwood)
	Populus tremuloides (aspen)
Salix planifolia	*Salix planifolia*
SELAGINELLACEAE	
Selaginella densa (selaginella)	*Selaginella densa*

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